STAFF REPORT

SUPPLY AND COST OF ALTERNATIVES TO MTBE IN GASOLINE

TECHNICAL APPENDICES

Adequacy of Marine Infrastructure

DECEMBER 1998

CALIFORNIA ENERGY COMMISSION

Pete Wilson, ***Governor***

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ADEQUACY OF MARINE INFRASTRUCTURE

Prepared For:

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AND

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1. INTRODUCTION

1.1 PARTIES

Purvin & Gertz, Inc., (Purvin & Gertz), was retained by Acurex Environmental Corporation (Acurex) on behalf of the California Energy Commission (CEC) to provide evaluations and assistance related to the proposed MTBE ban in California. Purvin & Gertz was retained to provide four deliverables: a presentation at a public workshop, a report on the supply costs of CARB gasoline and blend stocks from outside California, a report on the marine terminal infrastructure and associated limitations, and compilation of the final report combining Purvin & Gertz work with that of other consultants. This document is the report describing the marine infrastructure aspects of an MTBE ban.

This report has been prepared for the sole benefit of the CEC. Any third party in possession of the report may not rely upon its conclusions without the written consent of Purvin & Gertz.

Purvin & Gertz conducted this analysis and prepared this report utilizing reasonable care and skill in applying methods of analysis consistent with normal industry practice. All results are based on information available at the time of review. Changes in factors upon which the review is based could affect the results. Forecasts are inherently uncertain because of events or combinations of events which cannot reasonably be foreseen including the actions of government, individuals, third parties and competitors. ***NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY.***

Some of the information on which this report is based has been provided by others. Purvin & Gertz has utilized such information without verification unless specifically noted otherwise. Purvin & Gertz accepts no liability for errors or inaccuracies in information provided by others.

Two other consultants, Mathpro, Inc. (Mathpro) and Energy Security Analysis, Inc. (ESAI) are preparing parallel reports on other aspects of the MTBE ban under separate contracts with Acurex. Although the goals of the work are joint, the three consultants, Purvin & Gertz, Mathpro and ESAI, are working independently and none is responsible for the work or results of another. Neither Mathpro nor ESAI is responsible for any results presented in this report.

1.2 PURPOSE AND BACKGROUND

Legislative proposals have been made in California which would ban or restrict the use of MTBE as a gasoline blending component. MTBE is widely used in California as part of refiners' efforts to comply with reformulated gasoline requirements imposed by the U.S. Environmental Protection Agency (EPA) and the California Air Resources Board (CARB). Mathpro is preparing linear program (LP) models of the California refining industry. These models are used to estimate the capabilities of the refineries to produce CARB gasoline

under a variety of scenarios and the capital and operating changes that would be expected to occur in the event that MTBE is banned or restricted under a variety of scenarios. ESAI is identifying the supply costs of various oxygenate alternatives to MTBE. Purvin & Gertz has prepared supply curves for CARBOB supplies from external markets for use by Mathpro. The scope of this study is limited to the adequacy of the marine infrastructure with respect to an MTBE ban. The results of all of the consultants will be combined into an aggregated report.

Policy recommendations regarding the path which should be followed with respect to the MTBE ban or restriction are to be made only by CEC. Purvin & Gertz makes no recommendation in this report whether any particular option is superior to another. Nothing in this report should be construed as making a policy recommendation. CEC is responsible for making any policy recommendations after giving appropriate consideration to the reports of all the consultants as well as to other information as may be deemed appropriate by CEC.

2. SUMMARY AND CONCLUSIONS

Two types of marine infrastructure may be needed to deal with the trade impacts of an MTBE ban: 1) marine terminals and port facilities and 2) marine tankers. Marine terminals and port facilities might be needed to handle both inbound and outbound shipments of a variety of petroleum materials including CARBOB, other finished products such as jet fuel and diesel fuel, unfinished materials or blendstocks such as alkylate, oxygenates such as ethanol, TAME, TBA or ETBE, and high vapor pressure materials such as pentanes or butanes. Marine carriers including both international flag carriers and Jones Act carriers would be needed to transport the cargo materials to and from the port facilities.

Important factors that limit or may limit marine transportation and may impact a ban on MTBE include:

- Insufficiency of the Jones Act fleet, particularly at higher utilization levels
- Inability to load high vapor pressure cargoes such as pentane onto marine carriers
- Unavailability of Jones Act LPG/pentane carriers
- Potential difficulties unloading marine-borne ethanol and transporting to consumption points

There are adequate Jones Act tankers for some volume of shipments from the U.S. Gulf Coast but the availability of such carriers may limit CARBOB deliveries over the intermediate term to volumes substantially below those that might otherwise be available. The scale of the prospective movements of domestic CARBOB to California and the tanker tonnage necessary to support such movements is large when compared to the overall Jones Act fleet. Additional tonnage may be necessary to support high levels of shipments. Over the long term such tonnage could be built if the anticipated need for the movements was of sufficient duration to amortize the costs. In the event that adequate Jones Act tonnage is not available, marine traffic may be directed to otherwise less economic foreign sources or destinations to take advantage of more available international flag carriers.

There is only very limited ability to handle marine cargoes of high vapor pressure materials such as pentanes and butane. There is no dedicated system for pentane. The San Francisco Bay Area lacks any ability to load butane. There is one dedicated LPG facility in the Los Angeles area which can handle some butane cargo volume into tankers. In the event that significant increases in butane shipment or any pentane shipment by marine carriers is anticipated, new facilities would have to be constructed to allow for shipment.

However, pentane is unlikely to be shipped by marine methods. Costs of accessing marine shipping to the U.S. Gulf Coast are excessive and adequate ships are not available. Rail offers the most likely alternative to marine shipping to the U.S. Gulf Coast. Given adequate lead time, marine systems could be developed to ship pentane to overseas markets if this proved economical.

There is not adequate marine infrastructure in place and dedicated to handle large volumes of ethanol imports. Since ethanol would have to be blended with gasoline at pipeline terminals, marine terminals for handling ethanol imports would be required to transship the ethanol to truck or rail carriers for delivery to pipeline terminals around the state. With adequate time, marine terminals could be retrofitted to handle ethanol as needed. It is more likely ethanol would be delivered preferentially by rail or truck from domestic sources.

There is adequate marine terminal and port facility infrastructure to handle a substantial increase in traffic in conventional products and crude oil. Market participants report an ability to handle hundreds of thousands of barrels per day of additional traffic in petroleum products. Refinery capacity for crude oil receiving, combined with that of third party terminals, is considered not to be a factor limiting crude oil throughput at refineries.

There is adequate marine terminal facility to handle imports of oxygenates other than ethanol. Except for ethanol, oxygenate imports would be directed to the refineries where they would be blended. Currently such facilities are used to import MTBE for blending at the refineries for which other oxygenates would substitute.

There are adequate international flag carriers to handle significant volumes of petroleum product shipments to or from California. The scale of such shipments is relatively small by world standards and could be accommodated using existing carriers. There are adequate international carriers to handle any possible increases in butane shipments. It is unclear that there are adequate international flag carriers to handle maximum volumes of pentanes and time might be needed to develop such carriers.

3. BACKGROUND

At the present time the system for delivering petroleum products to California relies mostly on refineries within the state to provide products. There are only very limited volumes of product imports and these arrive most commonly when there is some disruption in the refining system. MTBE routinely is received by marine methods as very little is produced within the state. Transportation of butane and propane mostly is by truck or rail. There is no significant trade in pentane. There are some small movements of pentane-rich streams by rail and truck mostly to and from fractionators located in the San Joaquin Valley. The West Coast often has had excess diesel-type materials that are shipped to foreign markets. There are some coastwise marine movements including movements from the San Francisco Bay area to Southern California and some trade with the Pacific North West and traffic to the Portland market. On the whole, the West Coast is a self-contained market for petroleum products.

Product movements, other than MTBE, from the U.S. Gulf Coast to California are unusual. The cost of marine transportation from the U.S. Gulf Coast is about eight cents per gallon or more. This cost barrier is fairly high when compared to prevailing price differences between the California and Gulf Coast markets. Consequently, it is not practical under normal conditions to transport products from the U.S. Gulf Coast for sale in the California market. Movements from the U.S. Gulf Coast can be attractive only in the case of short term market shortfalls in California. If California prices rise appreciably, more than about eight cents per gallon above the U.S. Gulf Coast, then movements from the U.S. Gulf Coast can and do occur, but only in limited quantities.

Crude oils in California come from the state's own production and from waterborne deliveries. Most of the California crude oil is shipped by pipeline with dwindling volumes moving by marine carriers. California crudes carried by waterborne means are decreasing both because of declining production in certain fields for which there is no other transportation available and also because new pipeline construction is reducing the need for marine shipments. Crude oils from Alaska and foreign sources are delivered by marine tanker directly to refineries and to third party marine terminals in the San Francisco Bay area and the Los Angeles area. The volume of these marine shipments has increased with time as overall refinery crude oil throughput has increased to pace product demand and as California crude production has declined.

Banning MTBE may cause fundamental changes in the relationship between California and markets in other parts of the world. It is possible that refineries may find manufacturing CARB gasoline difficult without MTBE and therefore that California refineries may be unable to manufacture all the products California needs. In that case, the state would become much more dependent on deliveries from other supply areas. Since there are no pipelines bringing petroleum products into California and rail or truck would be prohibitively expensive due to the distances involved, deliveries from other areas would have to arrive by marine carrier. Similarly, banning MTBE may cause refineries to manufacture some products that California does not need or cannot use, such as gasoline that does not

comply with CARB specifications. If that happened, then such products might have to be shipped by marine carriers to other markets. Marine transportation could play an important role in facilitating any needed changes in the relationships between California markets and the rest of the world.

Both tankers and terminals would be needed to handle additional marine traffic. An adequate supply of marine carriers must exist to transport the products to and from California. Adequate marine terminal space must exist to provide shore side handling of the products. A shortfall in either type of capacity would represent a failure of the marine infrastructure.

Nationality or “flag” of marine carriers is relevant to an MTBE ban. First, international flag tankers can carry international shipments. Such shipments can originate in a foreign port and be delivered to a U.S. port or originate in U.S. ports and deliver to foreign ports. Second, Jones Act tankers, which must be both U.S.-flagged and U.S.-built, are the only tankers authorized to carry cargoes originating at one U.S. port for delivery to another U.S. port. The Jones Act is more restrictive than merely preserving domestic waterborne commerce to U.S. flag vessels. U.S. flag vessels that were built in foreign shipyards are not authorized under the Jones Act to transport cargo from one U.S. port to another. There are other less relevant restrictions in the Jones Act as well.

Four different types of products movements have been identified that might be relevant to an MTBE ban. First, receipt of CARBOB or other products like jet fuel or diesel fuel into California might be needed. Second, receipt of ethanol or other oxygenates might be needed. Third, shipment of conventional products such as gasoline might be needed. Fourth, shipment of high vapor pressure components such as pentane or butane might be needed.

In principle an MTBE ban might also increase crude oil requirements at California refineries but this is not considered a significant marine infrastructure problem. Refineries typically have adequate crude oil handling infrastructure so that refinery throughput is limited by factors other than the ability to access waterborne crude oil. Second, there is adequate tanker capacity to handle world crude production. Alaskan production is handled by Jones Act tankers and more Jones Act capacity already is planned or under construction to be able to handle expected Alaskan production. All California production already has adequate transportation. Foreign production would be delivered by international flag tankers. Delivering more international crude oil to California is insignificant compared to existing world movements. Marine infrastructure for crude oil is considered adequate. There will be no further consideration of crude oil marine infrastructure requirements in this report and all further references to marine infrastructure refer to materials other than crude oil.

4. PORT FACILITIES

Marine terminals and port facilities for petroleum products include both refinery marine facilities and third party terminals. Both these types of facilities might be important to responding to an MTBE ban. The roles played by the two types of facilities overlap to some extent but each has its own strengths.

4.1 REFINERY FACILITIES

All major refineries in California have access to waterborne transportation systems but the design of most refinery systems is not optimal for mitigating the impacts of an MTBE ban. Refinery marine facilities for light products tend to be designed for limited volumes and to be oriented mostly for outbound shipments. Refineries as a group are able to handle inbound MTBE shipments. No refinery in California has any capability to load vessels with pentane blends as these exceed normal vapor pressure limitations. Refineries generally lack marine facilities oriented toward ethanol as well.

Refineries typically cannot receive large volume shipments of light products. Refineries mostly are sources of such materials, not destinations, though they typically are able to handle MTBE or small volumes of intermediates like naphtha. Refineries are inadequate to serve as terminals for large volumes of waterborne CARBOB or finished product deliveries.

Refineries typically can load marine vessels with light products or have adequate access to facilities to do so. Light products, particularly gasoline and diesel fuels, have been shipped regularly from California refineries into coastwise and international trade. Refineries' ability to load vessels with volatile light products may be limited by permit restrictions related to air emissions associated with loading marine vessels.

Loading pentane blends at high vapor pressure requires specialized loading equipment that all California refineries lack. Shipping such material is unusual and no refinery has installed the needed equipment yet. Before the introduction of CARB gasoline about two years ago, California refineries typically would not isolate pentane within the refinery or seek to ship it as a product. Because of CARB gasoline's stringent specifications, California refineries now isolate some pentane from gasoline to control vapor pressure below CARB's 7.0 psia limits. Over the past two years some refineries may have experienced containment problems with pentane in the summer but these have been alleviated without resorting to marine shipments. Refinery infrastructure is wholly inadequate for waterborne shipment of pentane.

California refineries typically are unable to ship butane by marine carriers. No California refiner has its own facilities to load butane onto marine carriers. Refineries more typically use rail transportation to handle butane materials. Refinery marine infrastructure for butane loading is inadequate for waterborne shipment of butane.

Waterborne ethanol shipments could pose problems for refineries. Refineries can receive oxygenates but are not prepared to ship oxygenates prior to blending. Refineries typically

can receive MTBE cargoes and regularly do so to blend CARB gasoline. In principle, the same facilities might be used to handle ethanol or other oxygenates. On the other hand, refineries have had little or no need to transfer the neat MTBE onto rail cars or trucks. MTBE has been blended with gasoline at the refinery and shipped as part of finished gasoline in the pipeline network. Only a limited part of the state's need for ethanol would be for use at the refinery and most would be blended with the refinery-produced components of CARB gasoline at the point of truck loading, usually a pipeline terminal. Refineries would blend only as much ethanol as would be consumed by gasoline shipments by truck from the refinery site itself. Refinery infrastructure is inadequate to handle waterborne ethanol shipments except to the extent such shipments would be blended with gasoline at the refinery.

Oxygenates other than ethanol would be used in the same manner as MTBE has been used. MTBE has been received mostly by marine carriers so a system is in place that can be used for alternative oxygenates. Some review of the technical details of each refinery's system may be needed to ensure that all components are suitable for the substitute oxygenate. The oxygenate would be blended with the refinery-produced gasoline components at the refinery to produce finished CARB gasoline in the same general manner as MTBE is. The exact volume of oxygenate that would be used may be different for TBA, TAME or ETBE than it is for MTBE. Hence, the utilization of these facilities may change, however, such a change is not considered likely to be a material problem deterring an MTBE ban.

4.2 THIRD PARTY MARINE TERMINALS

Third party marine terminals also can contribute to handling marine traffic resulting from an MTBE ban. Third party terminals typically are organized differently than refinery systems and often have greater flexibility to handle new patterns of movements.

Third party marine terminals typically are designed to be able to receive large marine shipments of finished light products. An important part of the historical business of such terminals has been in receiving such shipments in time of shortage. Third party marine terminals typically have good pipeline connections allowing shipment of products into the pipeline network. Most areas of the state should be accessible via pipeline transportation to products received via third party marine terminals. Third party marine terminal infrastructure is adequate to handle very large volumes of light products delivered to California.

There is only one third party marine terminal in California with the ability to load butane onto marine carriers. That facility is in the Los Angeles area and is connected to only some of the Los Angeles area refineries. There is no third party marine terminal in the San Francisco Bay area with the ability to load butane onto marine carriers. Third party marine terminal infrastructure is considered inadequate to handle significant increases in waterborne butane shipments.

There is no third party marine terminal in California handling shipments of pentane or high vapor pressure pentane blends. Third party marine terminal infrastructure for pentane

loading is inadequate to contribute to resolution of any further pentane surpluses associated with an MTBE ban.

Third party marine terminals as a group have at best limited rail loading facilities that could be used for ethanol. Third party marine terminals have not been required to transship ethanol from marine carriers to rail cars and do not have facilities in place to do so.

Third party marine terminals have been important in handling MTBE in the past and could contribute to receipts of other oxygenates in the future. To the extent that refineries are unable to handle any volume increases associated with oxygenates such as ETBE or TAME, third party marine terminals are considered able to supplement refinery abilities.

Third party marine terminals are market responsive and have good ability to shift services to accommodate the needs of the marketplace. The terminals historically have accommodated a wide range of transportation and storage needs for petroleum products, MTBE and other materials. The third party terminals generally are able and willing to modify their systems as necessary to meet market demand.

Third party marine terminals require adequate time and incentive to install infrastructure modifications. Third party marine terminals generally require some firm commitment from facility users prior to undertaking expensive modifications. The time needed to complete modifications depends on the scale of the modifications but the time needed for third party terminals to install modifications once the necessary permits are in hand is not likely to be a factor limiting the banning of MTBE.

Third party marine terminals have a large volume of capacity. Terminal utilization is not at an historical high point. There were terminal expansions in recent years to accommodate seasonal MTBE handling and other transient needs that remain in service and which could be used to handle products in the event of an MTBE ban. The capacity of the marine terminal system probably exceeds any reasonable requirement for receipt of products.

A survey was taken of refinery and third party terminal operators to determine the adequacy of the industry infrastructure to respond to any increases in marine shipments or receipts resulting from an MTBE ban. The survey results were compiled by the CEC staff and individual company responses are confidential under the Petroleum Industry Information Reporting Act (PIIRA). Summaries of responses were provided to Purvin & Gertz to support the preparation of this report.

The response to the survey is considered adequate but incomplete. Not all companies responded to all questions and some smaller companies failed to respond. No adjustment of the numerical responses was made and the numbers in this report correspond to summaries of responding companies without compensation to account for the non-responding companies.

With respect to receipts of products, the capacity of the industry is very high and quite under-utilized. Companies reported from 20,000 to over 500,000 barrels per day of receipt capacity. Survey responses indicated that under normal summertime conditions, average

receipts ranged from zero to 20,000 barrels per day at various terminals. The survey indicates that there is very substantial capacity available at marine terminals to receive light products and such capacity is not considered a limiting factor.

4.3 COSTS OF UTILIZATION

The cost of receiving products would be a function of throughput and determined by contractual relationships. The terms of such contracts are highly variable.

The actual costs of operating a third party marine terminal or the marine portion of a refinery system are largely fixed. The variable costs are mostly electricity to run pumps and a small amount of manpower to receive tankers or barges. Hence the per barrel costs incurred by the terminal operator are inversely related to throughput.

Third party terminal facilities can be contracted on a variety of bases. Agreements can be short term or long term. They can call for segregated or community storage.

If a lessee wishes to use a tank for only a short period, for example to receive just one cargo and store it, then the terminal contract will be very short term, typically one month. The costs to the lessee for such a contract would be expected to reflect supply and demand at the time the contract is signed as well as the perception on the part of the lessor of the importance of the contract to the lessee. At times of very high utilization such rates can be quite high, as much as perhaps $1 per barrel per month for marine terminals and even higher rates have been reported at high utilization, landlocked terminal locations. When the utilization of terminals is low, such rates can be quite low, perhaps as low as $0.20 per barrel per month or less.

If a lessee wishes to use a tank for a longer period, perhaps one year, then rates tend to be somewhat less volatile and very high peak prices typically would be avoided.

If a lessee wishes to utilize a tank on a very long term basis, say five to ten years, then the lease rate becomes is capped at a level that is more or less reflective of the cost of building tankage. If the lessor attempts to charge a higher price, then the lessee typically would seek a more competitive quote from some other party able to build a new tank and charge a fair price for its use or build the tank himself. The cost of tankage is dependent on design, size, location and other factors but long term lease rates around one cent per gallon of tank capacity per month are adequate in most locations to pay for new tankage and charges of two cents per gallon of tank capacity per month are above the reasonable range for California.

The costs of using a tank on a long term lease are dependent on utilization. If a tank is filled and emptied on the average once per month, then the costs of a long term lease as described above would be one to two cents per gallon. If the tank is filled and emptied twice per month or “turned” in industry parlance, the terminal operator typically would make a nominal charge for the second turn of the tank, perhaps 0.1-0.2 cents per gallon. Hence the average cost per gallon of product might fall nearly in half in this case. It is in the interest of the tank lessee to utilize the tank highly to reduce his unit cost. On the

other hand, if the tank is turned more quickly, the possibility increases that some delay in either the marine shipments or the pipeline shipments would lead to an outage of product or the ship having to wait for tankage to be available and incurring costly demurrage. For marine deliveries, a tank utilization of two turns per month would be quite high but within the range of commercial experience. A utilization of one turn per month is considered reasonable.

Storage can be either segregated or community with segregated storage costing more than community storage. Segregated storage refers to a separate tank or tanks set aside for the exclusive use of one lessee. Community storage refers to using a single tank or system of tanks for commingling the products of all lessees. The community storage operator has the opportunity to utilize available tank space for additional lessees until the storage is completely utilized while no such opportunity exists for the operator of segregated storage. Consequently, the lessor is likely to charge each lessee less for using community storage than for segregated storage.

There are many variables affecting the per gallon product cost of accessing marine terminals. In light of all these variables and considering the typical costs of utilizing storage, the overhang of capacity in the California market, and the relationship of available handling capacity versus anticipated availability of externally-produced CARBOB, a figure of 0.75 cents per gallon is considered reasonable for evaluating the costs of importing CARBOB. While higher costs could be incurred for some users or over the short term, such costs are considered to be unsustainable over the long term.

5. MARINE CARRIERS

5.1 CONVENTIONAL TANKERS - INTERNATIONAL FLAG

International flag tankers can carry international shipments. Such shipments can originate in a foreign port and deliver to a U.S. port or originate in U.S. ports and deliver to foreign ports. International flag carriers are banned from carrying cargo originating in one U.S. port to another U.S. port. Petroleum shipments to and from the U.S. Virgin Islands are able to use international flag carriers to U.S. ports.

The supply of international flag carriers is very large because of the very large scale of international product movements. Average daily international shipments of naphtha, gasoline, diesel fuel and kerosene total approximately 8 million barrels. The fleet to handle these shipments is very large and there is appreciable seasonal variation in trade in the various petroleum products.

The California share of world demand for light petroleum products is not large. Because the scale of international movements of petroleum products that might result from an MTBE ban is so small compared to total movements and total world demand, the tanker demand that would result is considered unlikely to have a measurable impact on world demand or tanker market conditions.

5.2 CONVENTIONAL TANKERS - JONES ACT

The Jones Act places restrictions on vessels carrying cargo between U.S. ports. Such vessels generally must be U.S.-flagged, U.S.-built, U.S.-manned and U.S.-owned. The supply of such vessels is far smaller than the supply of international-flagged carriers as their costs are higher and these vessels as a group are competitive only within U.S. waters.

As reported by the U.S. Maritime Administration, Office of Ports and Domestic Shipping, there are 90 privately owned Jones Act tankers with a total capacity of 6.9 million deadweight tons. Many of these carriers were built for crude oil service between Alaska and the Lower 48 states. Some are small product carriers used predominantly in the Northeast. Only about half of those 90 tankers are product carriers of greater than 35,000 deadweight ton capacity that might be suitable for carrying products from other U.S. ports to California.

Many of these tankers have specified retirement dates within the next few years. About one quarter of the larger product carriers will be retired by 2002 and more than half will be retired by 2010. The same general pattern is true for crude carriers and as a result, new Jones Act tankers are being planned just to keep an adequate fleet to move Alaskan crude oil. Few or no new product carriers are planned for construction.

The balance between supply and demand for these tankers is not entirely clear since many of the tankers are owned by oil companies for their own use. Tanker transportation is

important to some Northeast markets and tankers for those markets would be unavailable almost regardless of price.

Moving large volumes of petroleum products from the U.S. Gulf Coast area to California could require significant tonnage. A single 30,000 dwt tanker continuously carrying product from the Gulf Coast to California would be able to contribute on average about 8,000 barrels per day to California's supply of petroleum products. That same tanker could, in principle, additionally move a similar volume of surplus, non-CARB products from the West Coast back to Gulf Coast area on a backhaul.

Between 30,000 and 40,000 barrels per day of MTBE is delivered to the West Coast from the Gulf Coast in Jones Act tankers. In the event that the marine delivery of oxygenate from U.S. ports to the West Coast is reduced by an MTBE ban, this volume of gasoline might be substituted without accessing additional tanker capacity. This outcome is considered most likely in ethanol cases in which it is unlikely that domestic marine oxygenate shipments would be significant. In those cases the oxygenate is more likely to be shipped by rail to the pipeline terminals in California. In the cases involving TBA, TAME or ETBE, the marine capacity currently carrying MTBE most likely would be converted to the new oxygenate and would not be available to ship CARBOB or other products.

It is unlikely that large volume movements on the scale of 100,000 to 200,000 barrels per day of gasoline or blendstocks from the U.S. Gulf Coast to California could be accommodated with the existing Jones Act tanker fleet. Shipping 200,000 barrels per day of gasoline from the U.S. Gulf Coast would require about 600,000 tonnes of additional Jones Act tanker capacity even if the MTBE tonnage could be converted to gasoline.

There are domestic barges which can also be used to carry products between U.S. ports. Such barges can be cost effective at reasonable distances. Barges are reasonable to use for coastwise trade between the Pacific Northwest and California but are considered impractical for movements from the Gulf Coast. The availability of these barges and the relatively small volume of CARBOB that might be accessible in the Puget Sound refining system indicates that the marine infrastructure for delivering light products to California from the Puget Sound is adequate.

There is a mismatch between the amount of CARBOB that might be available on the U.S. Gulf Coast and the availability of Jones Act tankers that could transport the product to California. The factor limiting availability of CARBOB is more likely to be tankers than Gulf Coast refining. The Jones Act fleet is inadequate to make sustained, high volume deliveries of light products to California from the U.S. Gulf Coast. The Jones Act tanker infrastructure is inadequate to allow California to access all the products that might be available on the U.S. Gulf Coast.

5.3 HIGH VAPOR PRESSURE CARGO CARRIERS

International shipments of high vapor pressure cargoes such as pentane could be accommodated by the existing fleet of marine carriers. The Jones Act tanker fleet contains only one LPG carrier and would be wholly inadequate to carry more than a nominal

quantity of pentane even if that ship were fully available. To access the high capacity U.S. Gulf Coast market, barges are considered too small and consequently, that market would be unavailable to appreciable pentane shipped by marine methods. Pentane marine cargoes likely would be confined to the international market.

5.4 COSTS TO ACCESS MARINE CARRIERS

"Worldscale" refers to the New Worldwide Tanker Nominal Freight Scale as published annually by the Worldscale Associations of London and New York. The Worldscale schedule provides standardized shipping costs between world petroleum ports and includes consideration of shipping time, typical carriage terms, relevant port and canal fees and the like. Worldscale is widely used to estimate consistent shipping costs for diverse voyages.

Economies of scale favor larger tankers. Large tankers generally are less expensive to operate on a per ton or barrel of cargo basis than smaller tankers because many costs are fixed. Crew size does not increase on a basis proportional to tanker capacity. There are economies of scale in the construction of tankers as well. Because of these various economies of scale, large tankers typically charge less for their service than small tankers. These differences can be related to Worldscale. Very large tankers typically would charge less for a voyage than the standard Worldscale charge for that voyage. Small tankers might charge more than the standard Worldscale charge for the same voyage.

Market conditions affect how much tanker owners charge for voyages. When market conditions are favorable to tanker owners, voyage charges tend to move upward with respect to standard Worldscale costs. When tanker utilization is low, voyage charges tend to fall with respect to standard Worldscale costs.

Since the scale of prospective international shipments to and from the West Coast is small relative to world movements of petroleum products, an MTBE ban is unlikely to affect international market conditions. Consequently, no adjustment to typical tanker costs should be used in analyzing the landed costs of international petroleum products.

Because of Jones Act restrictions, market conditions in the U.S. domestic tanker market do not reflect international supply and demand. Typical costs to deliver products from the U.S. Gulf Coast to the West Coast are reported by market participants at eight cents per gallon or more. Such charges are far higher than international flag carriers would be expected to charge for such a voyage were they allowed to compete in that market based on reports of what they charge for other markets and the standard Worldscale costs.

As discussed above, some volume of products might be transported to California from the U.S. Gulf Coast, particularly in the ethanol cases, without disrupting Jones Act tanker markets. That volume is reflective of the volume of MTBE currently being transported by Jones Act carriers, about 40,000 barrels per day.

For some limited increased volume above the 40,000 barrels per day level, Jones Act tanker markets might continue with small price increases. This increased volume is

estimated at no more than an additional 60,000 barrels per day or a total of 100,000 barrels per day. If long term commitments were made for such volumes, these commitments would mitigate some cost pressure. Tanker owners would be relieved of risk of idle time for their tankers in the California service.

Using the existing Jones Act tanker fleet, regular shipments of products including oxygenates from the U.S. Gulf Coast to California beyond 100,000 barrels per day are considered not feasible. Additional tanker capacity would have to be developed to allow such shipments. Over time the capacity to move such products will diminish unless new tankers are built because of scheduled retirements.

The cost of accessing new Jones Act tankers would depend on size. The most practical and lowest cost transportation would be provided by tankers sized at the maximum that could pass through the Panama Canal, “Panamax” tankers. Tankers larger than this size would need to go around South America which is considered uneconomical.

The least cost transportation would be provided by long term charters for the economic life of new Jones Act Panamax tankers. Under these conditions, the estimate of eight cents per gallon used for existing tankers is thought to be sufficient to make such tankers economic. If smaller tankers or shorter charter terms were used, then higher costs would be needed.

6. REMEDIAL ACTIONS

In the event of inadequacy of marine facilities, there are a number of possible compensatory actions that might be taken. These actions could mitigate the impacts of certain types of inadequacies.

First, receipt of CARBOB or other products like jet fuel or diesel fuel into California might be needed. Second, receipt of ethanol or other oxygenates might be needed. Third, shipment of conventional products such as gasoline might be needed. Fourth, shipment of high vapor pressure components such as pentane or butane might be needed.

6.1 PORT FACILITIES

No remedial actions are anticipated for the receipt of CARBOB or other products like jet fuel or diesel fuel. Existing capacity is considered adequate for any likely volume of receipts.

6.1.1 ETHANOL TRANSSHIPMENT

An infrastructure shortcoming has been identified for the receipt and transshipment of waterborne ethanol. Ethanol might be received by rail or truck rather than marine carrier. Since much of the available ethanol is manufactured within the U.S., such movements may be the least costly means of accessing ethanol in any case. Such movements could be directed to pipeline terminals without transshipment at coastal marine terminals or refineries. Any marine ethanol receipts would be sent preferentially to refineries for their own local blending. To the extent that ethanol transshipment capacity still is needed, third party marine terminals could retrofit given adequate incentive and time to do so. The costs of modifying existing third party marine terminals to transship ethanol would be in the low tens of millions of dollars but would not contribute significantly to the costs of banning MTBE.

6.1.2 PENTANE STORAGE/LOADING

A port infrastructure shortcoming has been identified for the shipment of high vapor pressure components such as pentane. This shortfall might be mitigated by diverting the shipments to domestic destinations served by rail or truck. Some regional storage of high vapor pressure components might allow the components to be utilized in the less restrictive winter period. Finally pentanes might be burned as a fuel rather than shipped.

Facilities to handle pentanes could be upgraded at some sites by making capital improvements to refineries and/or terminals. The capital costs of upgrading facilities to be able to load pentane onto marine carriers has been estimated at $2 million to $4 million per site. This cost is not considered material to a decision to ban MTBE.

Pentane storage capacity may be needed to facilitate pentane loading activities. Survey responses ranged from zero (capacity not needed) to a high of $125 per barrel of capacity.

Based on pentane's physical characteristics and the various types of tankage that may be employed in its storage, the upper end of the range of estimates is considered unreasonably high and a range of $30 to 50 per barrel is considered a reasonable estimate. The cost of installing adequate tankage to support loading pressurized vessels for pentane transport may be as high as $20 million per site. This cost level may be high enough to discourage use of marine transportation methods for pentane unless consolidated storage and loading sites could be developed.

6.2 MARINE CARRIERS

No infrastructure shortfall has been identified with respect to international flag carriers.

6.2.1 JONES ACT TANKERS

A possible shortfall of Jones Act tankers has been identified. A number of actions might be taken to mitigate such a shortfall.

Otherwise less attractive international destinations or origins might supplant U.S. destinations or origins to mitigate a Jones Act carrier shortfall.

Pipeline systems could be reconfigured to reduce the need for domestic marine shipments. The capital cost of reconfiguring such systems might be quite high and would have to be supported by a reliable long term need for such shipments.

6.2.1.1 TIME REQUIREMENT FOR JONES ACT TANKER DEVELOPMENT

Significant time would be needed to build more Jones Act tankers. The time to develop more Jones Act carriers can be split into three parts. First, time would be to develop the required commitments to use the carriers. Second, time would be needed to access shipyards to build the carriers. Third, time would be needed to complete construction and enter the carriers into service.

Tankers are expensive to build and would not be built unless there is a good prospect that they would be needed long enough to amortize their costs. In the event that the California refineries ultimately would retrofit to manufacture adequate CARB gasoline without MTBE and the requirement for external gasoline supplies would be for only a short time, such commitments could not be made and the tankers would not be built. Assuming that the outcome of an MTBE ban is that a long term need for tanker transportation would exist, a reasonable period of time, estimated at six months to one year, would be needed for the refining industry to study alternatives and make commitments to new tankers.

There are only a limited number of shipyards within the U.S. capable of constructing tankers. Jones Act tankers must be constructed by these shipyards. The U.S. shipyards have other commitments and would not be able to divert their resources immediately to construction of new Jones Act carriers to deliver U.S. Gulf Coast gasoline to California. An allowance of one to two years should be made to allow the shipyards to begin work on new tankers.

Once construction is begun on a new tanker, the construction time is approximately 24 to 30 months.

The total time from the time an MTBE ban is announced until new Jones Act tankers could be available is estimated at three and a half to five years at least and could be longer if a large number of tankers were required.

6.2.1.2 PIPELINE ALTERNATIVES

No products pipeline proposal that could mitigate a shortfall of Jones Act tankers has been identified at this time. The development of such a proposal lies entirely in the future.

Costs of a pipeline alternative cannot be estimated without detailed knowledge of the volumes to be shipped, their origin, and how such a pipeline proposal would fit into the existing pipeline infrastructure in the Southwestern U.S. There is no assurance that a pipeline alternative would be cost competitive with marine tankers or that prospective shippers would support such an alternative.

The time to develop a pipeline alternative, assuming that an economic alternative could be developed, is similar to the time to build new Jones Act tankers. An allowance of a six months to one year would be needed for the California refining industry to establish that a need exists. Three to four years are likely to be needed to identify an economic pipeline alternative, acquire needed rights of way and permits, acquire shipper commitments, finance and build the line.